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exposition of some of the main logical doctrines of the first volume of Whitehead and Russell's *Principia Mathematica.* In Chapter V Professor Lewis outlines a system of logic differing essentially from that of Russell in the meaning assigned to the fundamentally important relation of implication. Finally, in Chapter VI the leading views on mathematical and logical *method* are compared and contrasted. In the Appendix, Professor Lewis gives a translation, from Latin, of two fragments from Leibniz on the logic of classes.

The reviewer regrets that the author has omitted all mention of the various problems of postulational technique, as well as of *Mengenlehre*—problems intimately associated with the advance of mathematical logic. But in spite of these, perhaps inevitable, omissions, Professor Lewis, in presenting for the first time the connected history of the subject, has succeeded admirably.

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College Algebra. By H. L. RIETZ and A. R. CRATHORNE. Revised Edition. New York, Henry Holt and Co., 1919. (First Edition, 1909.) 8vo. 14+268 pp. Price $1.60.

This new edition of the Rietz and Crathorne *College Algebra* differs from the first (*a*) in the addition of new exercises and the alteration of figures in old ones, (*b*) in the omission of some topics not in the main line of development, and (*c*) in a rewriting of certain sections which proved hard to teach in the original form.

The changes in the exercises are sufficient to undermine the utility of the sets of solutions which come into being on any campus when the same book has been used for several years. In some cases, in the interest of more careful grading, the order of examples has been changed and easy examples have been added. Other new examples introduce applications in fields not previously touched—in at least one case, involving 'war bread,' in a field which did not exist in 1909.

In the problems on the Theory of Equations, the authors have lost an excellent opportunity to fall in with the modern trend towards unification. Several problems (pp. 146–7) call for the depth to which a sphere of specified material will sink in water, but the necessary cubic equation is always given all 'set up.' If the student were asked to show that the depth to which a sphere of radius r and specific gravity ρ will sink is the root between 0 and $2r$ of the equation $x^3 - 3rx^2 + 4\rho r^3 = 0$, he would have to combine with the theory of equations a little solid geometry (the formula for a spherical segment), a fundamental physical definition, and a physical principle. This seems to be a striking instance of a useful bit of mathematics and physics which is not adequately treated in any course because it draws on physics and two separate mathematical subjects. Perhaps, moreover, the inclusion of this general equation would have helped the authors as well as the student, by making more likely the detection of the errors in the constant terms in Ex. 18 and 19 on page 146 in the revised edition. These errors really imply that the specific gravity of yellow pine is .9657 and of ice .693, although the first edition gives correct values, .657 and .93. It may be that this error arose from the desire not to ask (as the first edition did) for the determination of an answer to three decimal places when the given specific gravity was accurate only to two places.

Among the topics omitted is the discussion of the maximum or minimum value of the quadratic function. This omission is to be regretted if it be accepted, as the Committee on Mathematics Requirements recommends, that the choice of topics should consider primarily those who go no further in mathematics. An introduction to the mathematical discussion of maxima and minima, with some applications to problems, seems highly desirable for such students. Of course, if the book is primarily for those who will go on to the more thorough treatment possible in a calculus course, the omission is justified.

The book is improved by the omission of the detailed discussion in the first edition of the use of undetermined coefficients in expansions in series. But it would seem desirable at least to mention the fact that such coefficients are used for other purposes than partial fractions and to include a few simple examples,—such as, for instance, determining a, b, and c so that the curve $y = a + bx + cx^2$ should pass through three specified points.

Sections rewritten include the discussion of 'equivalent equations,' which in the first edition were handled too abstractly for college freshmen. The new treatment calls attention to the possibility that redundant or defective solutions may arise in the course of formal work and illustrates the point with some good simple examples. Other sections rewritten are those on mathematical induction, which have been much improved. The example worked out in the text $[1 + 3 + \cdots + (2n - 1) = n^2]$ is perhaps the simplest that can be selected in the necessary formal work, and is much more typical of the bulk of the exercises given than was the example used in the first edition. Another example is explained very carefully to show that the second part of the proof is necessary—*i.e.*, the proof that if the formula is true for $n = r$, it is true for $n = r + 1$. This example, however, is perhaps not the best possible "pathological case," as it is unlike any that the student has to prove. Perhaps a better instance would be a formula like $\Sigma n = \{n^3 + 17n - 6\}/12$, which is true for $n = 1$, 2 or 3, but not for $n = r + 1$ if true for $n = r$. Students are usually interested in the idea that in this and similar cases, untrue formulas can always be constructed which will be true for any finite number of values of n; and this fact might well be mentioned, either here or in connection with undetermined coefficients.

The treatment of probability unfortunately does not here receive the radical revision which the real importance of the subject demands. It is to be hoped that some day the course for college freshmen will include a discussion of the great extent to which probability considerations are used implicitly in ordinary thought, as well as more explicitly in statistical sciences. Perhaps the next broadening of the usual material will be a discussion of frequency curves, with the connecting argument that probability is relative frequency. The book under review, however, goes very little further than the first edition, in which probability is limited to games of chance, expectation of life, and expectation of money. The authors of this book might seem to be peculiarly the ones to make the extension proposed, on account of their statistical interests, but apparently they did not consider this revision of this book the time or place to do so.

In general the book is substantially improved and although it does not blaze out any new paths, seems well adapted to the needs of those who hold to the established system of a rather careful and extensive course in college algebra before analytic geometry and calculus are begun.

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BROWN UNIVERSITY,
February, 1920.

Lectures on the Theory of Plane Curves delivered to Post-Graduate Students in the University of Calcutta. By SURENDRAMOHAN GANGULI. 2 parts. Calcutta, University of Calcutta, 1919. 8vo. Part 1, 10 + 1–138b pp.; Part 2, 13 + 139–350 pp. + 17 plates.

Preface: "The present volume . . . is intended as an introductory course suitable for advanced students of geometry and assumes scarcely any further knowledge of analysis on the part of the reader than is to be found in most of the ordinary text-books on differential calculus and on analytical geometry. Throughout the whole work I have endeavored to give prominence to geometrical methods, as it appears that geometry, in judicious combination with analysis, is likely to simplify otherwise tedious and lengthy investigations. With this end in view, Professor Sylvester's Theory of residuation has been introduced at the outset and occasional application of the principle has been found very useful. I have carefully avoided complicated forms of equations but at times they have been found indispensable.

In teaching the subject constant recourse has been had to the classic treatises of Salmon and Clebsch, and the works of Basset, Scott, and others, have been frequently consulted. My obligations to these authors, which are probably much greater than I am aware of, are gratefully acknowledged. I am indebted on almost every page to the great work of Salmon on *Higher Plane Curves* and it is impossible to record in detail my obligations to this inspiring writer. The English edition of the great work of Salmon has been long out of print and it has been found necessary to publish a new text-book based on modern methods, with a view to remove the inconvenience experienced by the English-knowing students of the University."

Contents—Chapter I: Introduction, 1–10; II: Theory of plane curves, 11–32; III: Singular points on curves, 33–50; IV: Polar curves, 51–65; V: Covariant curves—the hessian, 66–81; VI: Polar reciprocal curves, 82–95; VII: Foci of curves, 96–103; VIII: The analytical triangle—asymptotes, 104–125; IX: System of curves, 126–138; X: Curves of the third order—cubic curves, 139–157; XI: Harmonic properties of cubic curves, 158–168; XII: Canonical forms, 169–203; XIII: Unicursal cubics, 204–215; XIV: Special cubics, 216–231; XV: Invariants and covariants of cubic curves, 232–243; XVI: Curves of the fourth order—quartic curves, 244–266; XVII: Trinodal quartics, 267–275; XVIII: Bicircular quartics, 276–305; XIX: Circular cubics as degenerate bicircular quartics, 306–315; XX: Special quartic curves, 316–328; Appendices, 329–345.

NOTES.

In *Historical Portraits* 1700–1850. *The Lives by C. R. L. Fletcher. The Portraits chosen by Emery Walker* (Part I, 1780–1800, Oxford, Clarendon Press, 1919) there are portraits of Newton and Halley. "Sir Isaac Newton," 29–33; opposite page 30 is a reproduction of the painting by John Vanderbank, at Trinity College, Cambridge. Edmund Halley, 33–36; opposite page 34 is a reproduction of the painting by Thomas Murray at Queen's College, Oxford.

The opening article (16 pages) of the second volume (1920) of *Norsk Matematisk Tidsskrift*, the organ of the Norwegian Mathematical Society, is a lecture on Evariste Galois delivered by the late Ludvig Sylow.